U.S. oepartment
of Transportation
Federal Aviation Administration

Advisory Circular

'FAR GUIDANCE MATERIAL

Subject: **COMPOSITE PROPELLER BLADE FATIGUE SUBSTANTIATION**

Date: 09/07/93 **AC No: 35.37-1**
Initiated by: ANE-110 **Change: 1**

1. **PURPOSE.** This change transmits revised pages for the subject advisory circular (AC).

2 **EXPLANATION OF CHANGE.** This change has been initiated to incorporate editorial corrections to the formula for standard deviation. The asterisks (*) in the left and right margins indicate the beginning and end, respectively, of the changes. The Change number and date of changed material is carried at the top of each page. Rearranged pages having no new material also carry the new Change number and date. Pages having no changes retain the same heading information.

3. **DISPOSITION OF TRANSMITTAL.** After filing the revised pages, this change transmittal should be retained.

PAGE CONTROL CHART

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		6	05/11/93

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(3) Specimen Monitoring.

(i) Each specimen should be strain gauged and have load cells to monitor the loads and stress distribution.

(ii) The propeller blade should be examined regularly for delamination or cracks.

(iii) The bending and torsional stiffness of each specimen should be measured at the outset of each test, and periodically monitored throughout the test. The frequency of stiffness monitoring should be closer during the failure process.

(iv) Testing should be continued after the initiation of failure to demon&rate damage growth characteristics.

c. Reliability and Service Life.

(1) Mean Endurance Limit. The mean endurance limit of each critical section is defined as: the mean steady and vibratory stress at which all samples tested would have failed had they all been tested to 500 x 10^6 cycles, or an asymptote representing the endurance limit. Customarily, this is established by: (1) "fitting" the coupon-derived S-N curve shape through each failure point, thereby extrapolating each failure to 500 x 10^6 cycles; and (2) computing the mean of these extrapolated failure points.

(2) Reliability. Being dynamically loaded components, the structural integrity of propellers may be governed by their fatigue, rather than their static strength. Accordingly, a reliability, at least as good as the "A" basis for static strength allowables of a normal distribution, should be demonstrated. That is, a reliability of 99 percent, with a 95 percent confidence level, must be demonstrated.

(3) Number of Test Specimens. The number of full-scale test specimens to be fatigue tested for each critical propeller section is optional, provided the required reliability is satisfied.

(i) For a prescribed reliability, the mean endurance limit (E_{50}) will be reduced by a factor (k), governed by the selected sample size (n) and the coupon-derived statistical * strength distribution, and the standard deviation (a) of the full scale data. More specifically, the 99 percentile endurance limit (E_{99}) may be expressed: $E_{99} = E_{50} - k\,a$; where (k) is a function of * the sample size (number of full-scale specimens tested).

(ii) For the normal strength distribution, (k) varies with sample size as follows:

Sample Size	Normal Distribution Reduction Factor
n	k
2	37.094
3	10.553
4	7.042
5	5.741
6	5.062
7	4.642
8	4.354
9	4.143
10	3.981
REF. Table 9.6.4.1, Mil-HDBK-5E, June 1, 1987	

Note: Use of available in-house, development data and analytic expertise, along with limited full-scale testing, may be used as an alternative in substantiating the required reliability.

(4) Service Life. For the purposes of establishing service life and granting vibration approvals, a final S-N curve will be drawn. It will bear the shape of the coupon-developed S-N curve, with an endurance limit at 500 x 10^6 cycles, including an appropriate service damage/environmental degradation factor. All anticipated operating steady and vibratory stresses should be below the 99 percentile endurance limit.

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